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ARMY STATIONING ALTERNATIVES SYSTEM
A Revision of the Division and Brigade Stationing System

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ENGINEER STUDIES CENTER

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This paper describes how ESC revised an existing decision support system to consider new stationing issues in support of a worldwide realignment of US Army units.

The revised system now has the capability to evaluate the impact of adding combat arms battalions onto installations. The study team updated installation and unit data to reflect planned unit reassignments. ESC exercised the model by examining a stationing package composed of combat arms divisions, brigades, and battalions. For each proposed unit, the system rates suitability of the installation's ranges and maneuver areas, rates social and economic impacts on the civilian community, and estimates the cost of new facilities required.

This report is more easily understood when read together with *Division and Brigade Stationing System: An Overview* (ESC, May 1988)

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ARMY STATIONING ALTERNATIVES SYSTEM
A Revision of the Division and Brigade Stationing System

Prepared by
Engineer Studies Center
US Army Corps of Engineers

May 1990

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CONTENTS

Figures

EXECUTIVE SUMMARY

This paper describes how the US Army Engineer Studies Center (ESC) significantly revised an existing decision support system to satisfy a new requirement--to consider stationing issues in support of a realignment of Army units.

In 1988, ESC completed the Division and Brigade Stationing System (DBSS) for the Assistant Chief of Engineers (ACE). This system summarized the potential of 28 installation complexes (in CONUS, Alaska, and Hawaii) to accept additional combat arms units in FY 92. The DBSS had four major modules--Environmental and Socioeconomic, Training and Operations, Facilities, and System. The entire system used the *Lotus 1-2-3* spreadsheet software to process all the data on a microcomputer. The DBSS considered four specific units--a heavy division, a light division, a heavy separate brigade, and a light separate brigade.

In September, 1989, the Assistant Chief of Engineers asked ESC to revise DBSS to add a capability to evaluate the impact of adding active component, combat arms battalions onto installations. ESC updated installation and unit data to reflect planned unit reassignments. ESC used the model to examine a classified stationing package composed of combat arms brigades and battalions (results provided to sponsor under separate cover). ESC also evaluated the impact of recently proposed base closures and subsequent unit moves.

ESC's Army Stationing Alternatives System (ASAS) is a significant improvement over its predecessor. The ASAS can support a decision to station any set of units composed of combat arms divisions, brigades, *and battalions.* For each proposed unit, the system--

- Rates suitability of the installation's ranges and maneuver areas.
- Rates social and economic impacts on the civilian community.
- Estimates the cost of new facilities required.

ESC's Army Stationing Alternatives System can contribute to a successful transition as the Army considers closing bases and restationing units in the US and overseas.

ARMY STATIONING ALTERNATIVES SYSTEM
A REVISION OF THE DIVISION AND BRIGADE STATIONING SYSTEM

I. INTRODUCTION

1. PURPOSE. This report describes the Army Stationing Alternatives System, an active component stationing model. This new model is a major revision to the Division and Brigade Stationing System. This new system screens selected U.S. Army installations to determine which are the most suitable candidates for the stationing of units.

2. SCOPE. During this analysis, the U.S. Army Engineer Studies Center (ESC)--

a. Revised the methodology which formerly rated the ability of installations to accept four specific maneuver brigades and divisions. This revision adds the ability to station active component, battalion-sized units. The revised model rates installations for any four combat arms battalions, brigades, or divisions.

b. Updated data for Fiscal Year 1992 (FY92) which had changed between 1988 and 1990.

c. Applied this methodology to screen 28 Army installations/complexes in the continental United States (CONUS), Alaska, and Hawaii to determine the most likely candidates for the stationing of selected units. In this case, ESC directly provided the sponsor with the results for a particular classified stationing package.

3. BACKGROUND.

a. **Initial Requirement for an Automated Stationing System.** In December 1985, the Deputy Chief of Engineers tasked ESC to develop an automated stationing system. The new system would integrate existing data systems into a product which Headquarters, Department of the Army (DA) stationing planners could use routinely. The completed system would screen installations to identify the best candidate sites for peacetime stationing of additional divisions or separate brigades. The Deputy Chief of Engineers directed ESC to rank 28 Army installations and installation complexes in CONUS, Alaska, and Hawaii.

b. **The Division and Brigade Stationing System (DBSS).** In mid-1988, ESC completed the DBSS. The model had four major parts--the Environmental and Socioeconomic Module, the Training and Operations Module, the Facilities Module, and the System Module. ESC published separate reports describing each module in detail,[1] and released a data book.[2] ESC had developed four generic units--heavy division, light division, heavy separate brigade, and light separate brigade. The completed system used the *Lotus 1-2-3*, a microcomputer-based

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[1] *Division and Brigade Stationing Study. An Analysis of Environmental and Socioeconomic Issues*, (ESC, September 1987), *Division and Brigade Stationing Study. An Analysis of Training and Operations*, (ESC, February 1988), *Division and Brigade Stationing Study. An Analysis of Facilities*, (ESC, June 1988), and, *Division and Brigade Stationing System. An Overview*, (ESC, May 1988).

[2] *Division and Brigade Stationing System: An Installation Data Book*, (ESC, April 1988).

spreadsheet software, to process all the data.[3] The results summarize the potential of 28 installations and installation complexes to accept an additional division or brigade in the target year. **Figure 1** defines the composition of installation complexes and **Figure 2** shows them on a map. In June 1988, ESC delivered the model to the Office of the Assistant Chief of Engineers (OACE), Installation Planning Division.

COMPLEXES	INSTALLATIONS INCLUDED IN COMPLEXES
1. Alaska Complex	Forts Richardson, Greely, Wainwright, and Yukon Training Site, AK
2. Fort Benning	Fort Benning, GA
3. Fort Bliss	Fort Bliss, TX and Bliss Range, NM
4. Fort Bragg	Fort Bragg and Camp MacKall, NC
5. Fort Campbell	Fort Campbell, KY
6. Fort Carson Complex	Fort Carson and Pinon Canyon Training Area, CO
7. Fort Chaffee	Fort Chaffee, AR
8. Fort Devens Complex	Fort Devens, Camp Edwards, and Sudbury Training Area, MA
9. Fort Dix	Fort Dix, NJ
10. Fort Drum	Fort Drum, NY
11. Hawaii Complex	Fort Shafter, Schofield Barracks, Wheeler Army Airfield, Dillingham, and the training areas of Kahuka, Kawailoa, Makua, and Pohakuloa, HI
12. Fort Hood	Fort Hood, TX
13. Fort Huachuca Complex	Forts Huachuca and Willcox, AZ
14. Fort Indiantown Gap	Fort Indiantown Gap, PA
15. Fort Irwin	Fort Irwin, CA
16. Fort Jackson	Fort Jackson, SC
17. Fort Knox	Fort Knox, KY
18. Fort Lee Complex	Forts Lee, A. P. Hill, and Pickett, VA
19. Fort Lewis Complex	Fort Lewis and Yakima Firing Center, WA
20. Fort McClellan	Fort McClellan, AL
21. Fort McCoy	Fort McCoy, WI
22. Fort Ord Complex	Forts Ord, Hunter-Liggett, and Camp Roberts, CA
23. Fort Polk Complex	Fort Polk, Peason Ridge and Horses' Head Training Areas, LA
24. Fort Riley	Fort Riley, KS
25. Fort Rucker	Fort Rucker, AL
26. Fort Sill	Fort Sill, OK
27. Fort Stewart Complex	Fort Stewart and Hunter Army Airfield, GA
28. Fort Leonard Wood	Fort Leonard Wood, MO

Figure 1. COMPOSITION OF INSTALLATION COMPLEXES

[3] *Lotus 1-2-3* is a trademark of the Lotus Development Corporation. Although ESC used this software (version 2.0) to develop the spreadsheet system, this in no way implies endorsement by the Engineer Studies Center or the U.S. Army Corps of Engineers.

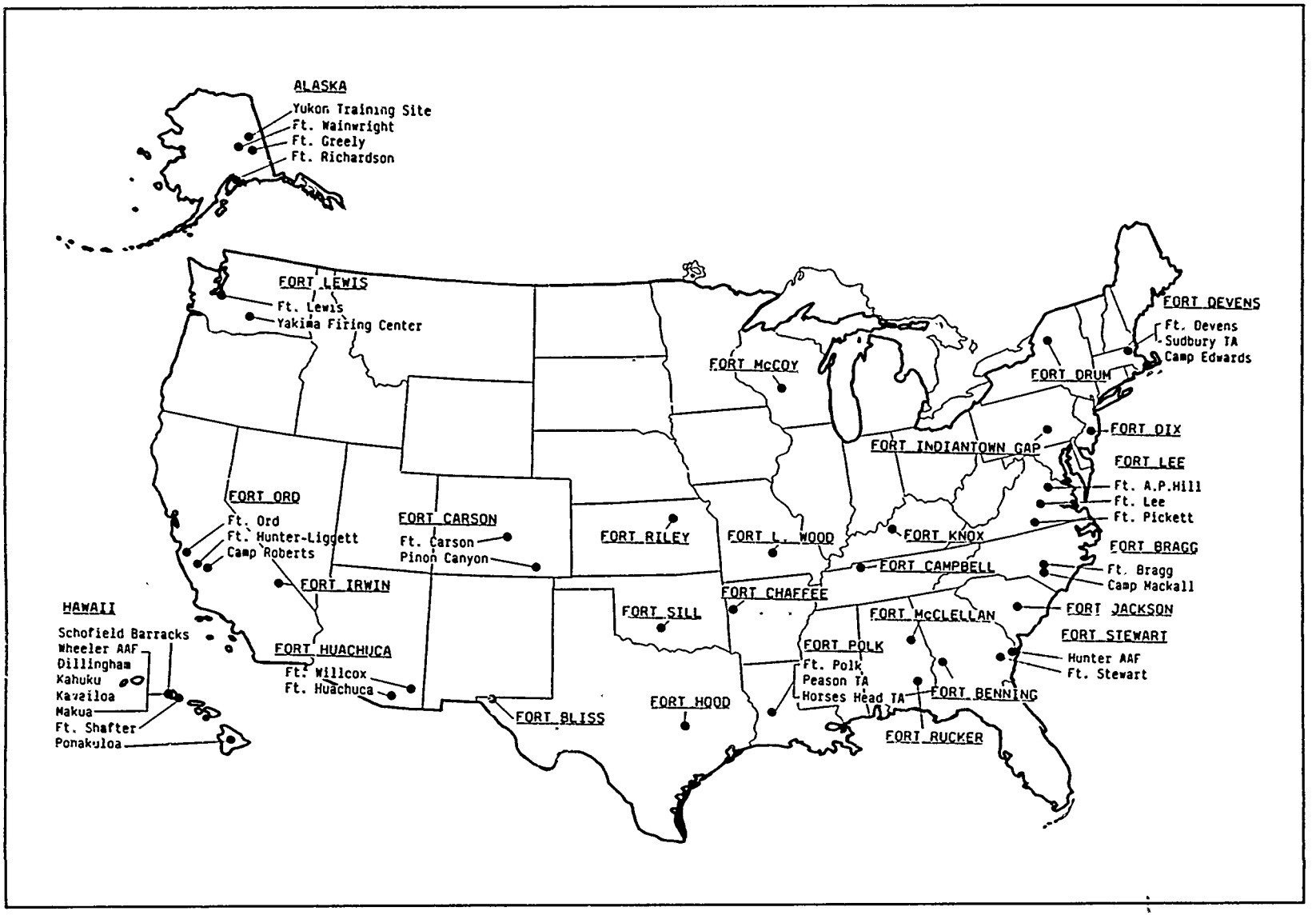

Figure 2. INSTALLATION COMPLEXES STUDIED

c. **Impact of the Long Range Stationing Study (LRSS).** During 1987 and 1988, a special task force under the DA, Deputy Chief of Staff for Operations developed a stationing system. The LRSS had a broad scope, which included analyzing current operations, base closures, as well as new stationing. The LRSS drew on some of the ESC analysis. Because of their expectations for the LRSS, the OACE did not update ESC's DBSS and the full system was not used in a real stationing analysis. Unfortunately, the LRSS study team never fully implemented their complex, data-intensive model.

d. **Recent Tasking.** In August 1989, MG Peter J. Offringa, the Assistant Chief of Engineers (ACE), expressed renewed interest in using the DBSS. The ACE asked ESC to analyze the facilities implications of restationing actions which might result from political decisions to reduce troop strengths outside the continental United States (OCONUS). On 29 September 1989, the ACE tasked ESC to revise the model to add battalions, to update the data, and to exercise the revised model with a classified set of units.

4. **TERMS OF REFERENCE.** Understanding the following key definitions is essential.[4]

a. **Installation complex:** Two or more installations combined to form a single entity for this analysis. Unless noted, *installation* and *installation complex* are used interchangeably.

b. **Target year:** The fiscal year (FY) in which the units will move to their new installation. (The target year for the 1988 DBSS and this study is FY 92.)

c. **Base case:** The level of stationing in the target year for each installation based on the *Army Stationing and Installation Plan (ASIP).*[5] This level directly identifies the number of military personnel and indirectly identifies the number and type of unit equipment at each installation.

d. **Base-case unit:** A active component unit which will be on an installation in the target year, according to the ASIP.

e. **Generic unit:** An active component division or brigade which the 1988 study proposed might be added to an installation in the target year. The four generic units were a heavy division, a light division, a heavy separate brigade, and a light separate brigade. This term applies only to units used in the original model.

f. **Proposed unit:** An active component combat arms division, brigade, or battalion which might be added to an installation in the target year. This term applies only to the units used in the revised model. The list of proposed units is classified in this study.

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[4] A complete list of terms of reference is available in *Division and Brigade Stationing System; An Overview,* (ESC, May 1988).

[5] *Army Stationing and Installation Plan,* (U), computer-generated report (Department of the Army, Assistant Chief of Engineers, Installation Planning Division, July 1989).

5. **ASSUMPTIONS, LIMITATIONS, AND TIIEIR SIGNIFICANCE.** Although none of the original assumptions changed in the revised model, ESC added one assumption and reiterated one limitation.

a. **Assumption:** Proposed units are either combat arms battalions, brigades, or divisions. **Significance:** The revised model correctly assesses the impact of stationing additional battalions, brigades or divisions. (Note, the DBSS could handle only maneuver brigades and divisions.)

b. **Limitation:** The revised system does not presently consider the impact of reserve component units. **Significance:** If the demands of reserve component units on ranges, maneuver areas, and facilities were considered, the relative ranking of several installations would probably change. The final version of the DBSS and this revised model both have a capability to address these issues. ESC did not use this capability because we did not have data which indicated which specific reserve component units would train at which installations.[6]

6. **METHOD.** The three major phases of the model revision described in this report are shown in **Figure 3.**

a. **Phase 1--Revise Data.** ESC and a representative from the OACE examined the existing DBSS to determine the data which needed updating and requested that data from the appropriate sources.

b. **Phase 2--Modify DBSS Model.** ESC revised the existing DBSS spreadsheets to accommodate new combat arms battalions. The twenty criteria in **Figure 4** remain unchanged from the original DBSS. For all criteria, the higher an installation's rating, the more capable it is of accepting a new unit.

c. **Phase 3--Evaluate Proposed Units.** ESC exercised the model stationing battalions, brigades, and divisions. **Figure 5** shows how the System Module multiplies the criteria ratings from the other three modules by user weights (W_1, W_2,...W_{12}) and sums them into an overall score (S). The System Module uses this score to rank each installation on its ability to accept an additional unit. After locating the first unit at the most suitable installation, ESC updated the data and exercised the model again for a second unit. In this stepwise fashion, ESC created a stationing scheme for all the new units. Because the unit list in this analysis was classified, ESC gave the results directly to the sponsor.

7. **FORMAT.** ESC calls the revised model, the Army Stationing Alternatives System. The new system is user-friendly, easily updated, and exportable. The next four sections detail the changes which ESC made to the DBSS modules and the final section is a summary.

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[6] The user needs to know how many days of each year the manuever areas are set aside for reserve component units. The system can correctly account for range loading and facilities requirements and assets when specific reserve component units are identified for an installation.

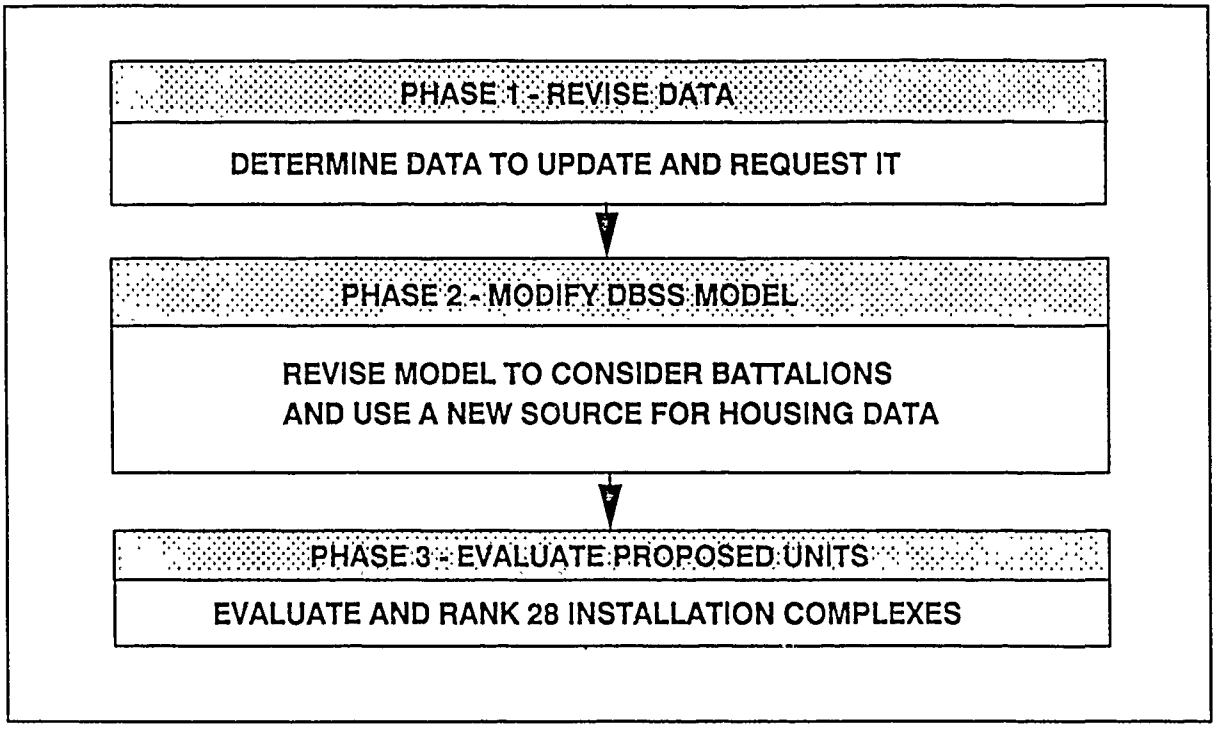

Figure 3. ANALYSIS PHASES

ENVIRONMENTAL AND SOCIOECONOMIC

1. ENVIRONMENT
2. ENCROACHMENT
3. LOCAL ECONOMIC IMPACT
4. NATIONAL ECONOMIC BENEFIT
5. WATER AVAILABILITY

TRAINING AND OPERATIONS

6. MISSION
7. MANEUVER LAND
8. INSTALLATION SIZE
9. RANGES
10. MOBILITY ACCESS
11. TRAINING VARIETY

FACILITIES

12. AIRCRAFT MAINTENANCE
13. VEHICLE MAINTENANCE
14. COMMAND, CONTROL AND ADMINISTRATIVE
15. AIRCRAFT & AIRCRAFT PARKING
16. MEDICAL
17. HOUSING
18. DINING
19. COMMUNITY SUPPORT
20. INFRASTRUCTURE

Figure 4. CRITERIA

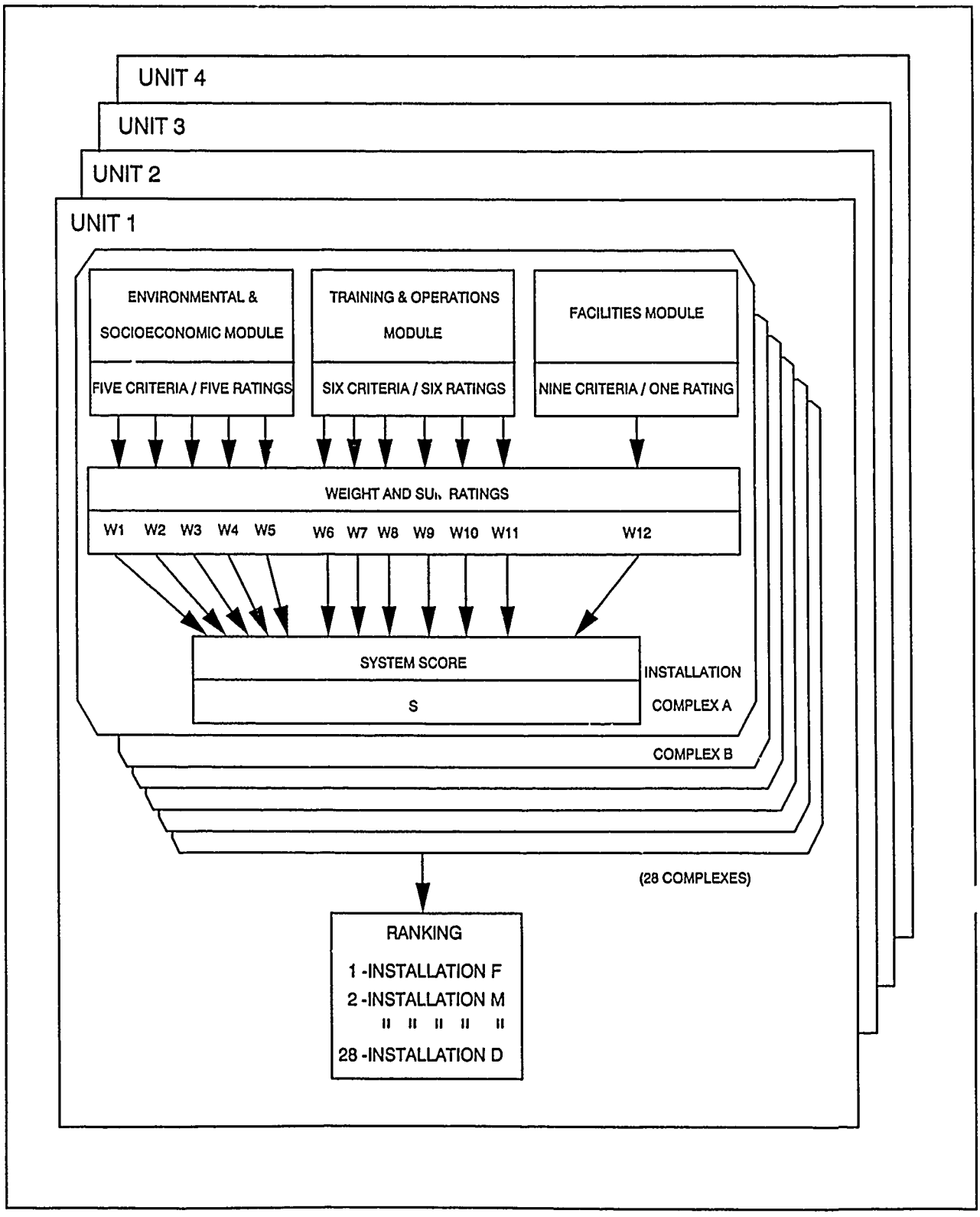

Figure 5. SYSTEM RATING AND RANKING PROCESS

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II. ENVIRONMENTAL AND SOCIOECONOMIC MODULE

8. **GENERAL.** This section presents detailed information on changes made to the Environmental and Socioeconomic Module. During this analysis, ESC reviewed existing criteria for rating installation environmental and socioeconomic considerations. The user can now rate up to four combat arms units, varying in size from a battalion to division, against any single base case. For the rest of this report, ESC refers to the Environmental and Socioeconomic Module simply as the Socioeconomic Module.

9. **CHANGES TO SPREADSHEET STRUCTURE.** For this effort, ESC used the basic system architecture of the original Division and Brigade Stationing System. The Socioeconomic Module checked five criteria--environment, encroachment, local economic impact, national economic benefit, and water availability.[7]

a. **Spreadsheets. Figure 6** shows the original Socioeconomic Module consisted of one spreadsheet titled SOCIO. For this revision, ESC retained the original spreadsheet and calculation order. The SOCIO spreadsheet first extracts data from the INPUT spreadsheet. Then the SOCIO spreadsheet extracts data from two spreadsheets in the Facilities Module--the HOUSING and HOUSEBC spreadsheets. This updating process requires only one command (Step 1). In the Systems Module, the MAIN spreadsheet weights the criteria and ranks the results by installation (Step 2).

b. **Formulas.** ESC did not change the five equations for the five criteria. Instead, ESC removed all references to the former generic units. This required revising formulas to reflect logic which did not apply to any specific unit.

c. **Calculations.** The SOCIO spreadsheet employs many conditional statements that add to spreadsheet complexity and size. To offset the size of these changes, ESC incorporated a new calculation technique into the SOCIO spreadsheet. The original spreadsheet has retained both the formula and calculated value for every criteria and sub-criteria, for all 28 installations, and for all four units. The revised spreadsheet keeps only four formula strings and converts the formulas in all other locations to values. ESC evaluates formulas in the combined listings of all 28 installations, all four units, and all five criteria. This results in a revised spreadsheet that is slightly larger than the original spreadsheet. However, calculating a more complex spreadsheet takes more time. The total updating time for this module is approximately three minutes versus the previous time of two minutes.[8]

d. **Base-case Revisions.** At this time, the model is not completely automatic. When stationing two or more units, the user runs the model to determine where to station the first unit. After this decision, the user must manually update the base case for the installation receiving the first unit. In the INPUT spreadsheet, the user revises: military population; income; land and air activity; and, housing requirements and assets. To realize the full impact of the revised data, the user updates the HOUSEBC and HOUSING spreadsheets and saves

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[7] *Division and Brigade Stationing Study: An Analysis of Environmental and Socioeconomic Effects*, (ESC, September 1987).
[8] This time was measured on a Zenith 248 with 9 MHz clock.

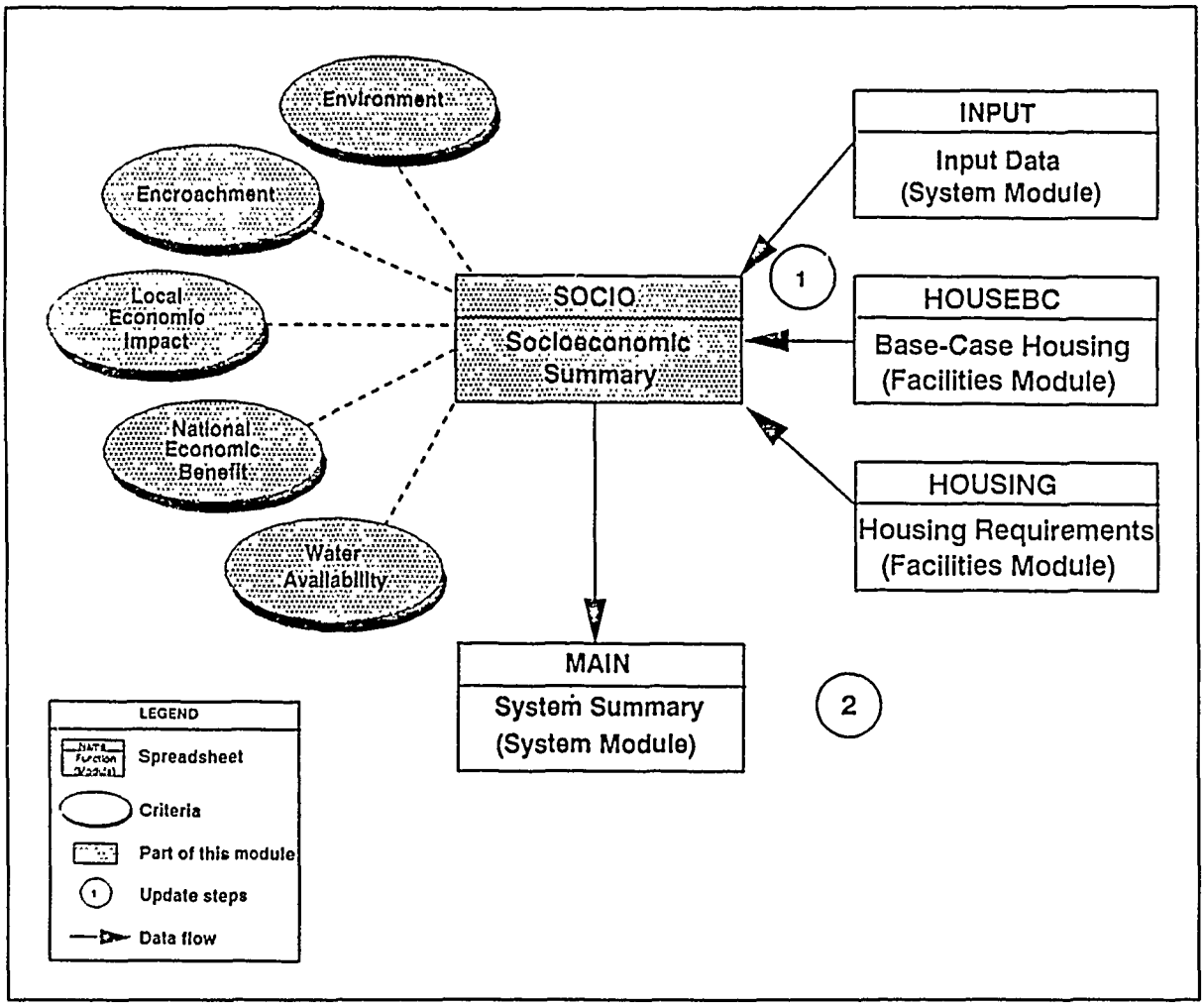

Figure 6. REVISED SOCIOECONOMIC MODULE STRUCTURE

them. The user then updates the SOCIO spreadsheet from INPUT *and* from the two housing spreadsheets.

10. CHANGES TO CRITERIA. There are no changes made to logic of the environmental and socioeconomic criteria.

11. CHANGES TO DATA. ESC changed both installation and proposed unit data in this module.

a. **Installation Data.** The SOCIO spreadsheet extracts new data from the INPUT and HOUSEBC spreadsheets.

(1) *Environment.* The INPUT spreadsheet contains data on installation population, both officers and enlisted. The SOCIO spreadsheet extracts this population data plus land activity data to calculate the environment criterion.

(2) *Encroachment.* The INPUT spreadsheet also contains data on installation air and land activity. The SOCIO spreadsheet extracts this data to calculate the encroachment criterion.

(3) *Local Economic Impact.* The INPUT spreadsheet also contains income in the installation's commute area along with salary estimates. The SOCIO spreadsheet extracts all of this revised data to calculate the local economic impact criterion.

(4) *National Economic Benefit.* The regional multiplier in the INPUT spreadsheet produces the national economic benefit criterion in the SOCIO spreadsheet.

(5) *Water Availability.* The SOCIO spreadsheet extracts data from the HOUSEBC spreadsheet of the Facilities Module. The HOUSEBC spreadsheet calculates data for military living on-post and off-post. The SOCIO spreadsheet uses all of this revised housing data to calculate an effective population for water use.

b. **Proposed Units Data.** ESC updated several military and civilian population values plus land and air activity factors of the proposed units. These data affect the installation's ratings of four criteria--environment, encroachment, local economic impact, and water availability.

12. SUMMARY OF THE SOCIOECONOMIC MODULE. This revision consists of changes to the processing procedures. ESC changed the formulas which referenced four specific generic units to reference any four combat arms units. The changes slightly increase the spreadsheet update time. The addition of battalion-size units did not affect the SOCIO spreadsheet. The SOCIO spreadsheet, however, does depend on revised data located in other spreadsheets.

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III. TRAINING AND OPERATIONS MODULE

13. **GENERAL.** This section presents detailed information on changes made to the Training and Operations Module. During this analysis, ESC changed existing criteria for rating installation training and operations for a unit added at an installation for any base-case year. The user can rate up to four combat arms units, varying in size from a battalion to division, against any base case. For the rest of this report, ESC refers to the Training and Operations Module simply as the Training Module.

14. **CHANGES TO SPREADSHEET STRUCTURE.** For this effort, ESC used the basic architecture of the original Division and Brigade Stationing System. The Training Module checked six criteria--mission, maneuver land, installation size, ranges, mobility access, and training variety.[9]

a. **Spreadsheets.** **Figure 7** shows the original Training Module contained two spreadsheets--TRAINING and RANGES. The TRAINING spreadsheet calculated five criteria, the RANGES spreadsheet calculated the ranges criterion. ESC retained the two spreadsheets but streamlined calculation order.[10] The user updates the RANGES spreadsheet from the INPUT spreadsheet and saves RANGES (Step 1). The TRAINING spreadsheet extracts data from the INPUT spreadsheet and range ratings from the RANGES spreadsheet (Step 2). The MAIN spreadsheet, of the System Module, weights the criteria ratings extracted from TRAINING and ranks the installations (Step 3).

b. **Formulas.** ESC did not change any of the six equations for the six criteria. Instead, ESC removed all references to the specific four generic units. This required--

(1) Changing the INPUT spreadsheet that provides basic unit and installation data to all modules. ESC made two changes. One change added a list that coded whether the proposed unit was a *battalion*, *brigade*, or *division*. The second change added a list that coded the proposed unit either as *light* or *heavy*.

(2) Revising formulas and logic so calculations did not apply to any specific generic unit. Most often, ESC accomplished this using conditional functions and lookup tables.[11]

c. **Calculations.** The use of conditional statements and lookup tables adds to the complexity and size of the spreadsheet. To offset the increase in size, ESC incorporates a new calculation technique into the TRAINING and RANGES spreadsheets. The original spreadsheets retained both the formula and calculated value for every criteria and sub-criteria, for all 28 installations, and for all four proposed units. The revised spreadsheet keeps only four formula strings and replaces formulas with values for 27 installations, for each of the four units,

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[9] *Division and Brigade Stationing Study: An Analysis of Training and Operations*, (ESC, February 1988).

[10] Originally the TRAINING spreadsheet extracted all the data from the INPUT spreadsheet and the RANGES spreadsheet extracted that part of this same data it required from the TRAINING spreadsheet.

[11] *Lotus 1-2-3* calls these tables horizontal and vertical lookup tables. ESC created a numbered index row or column so values could be compared to an index number and matched to a corresponding row or column.

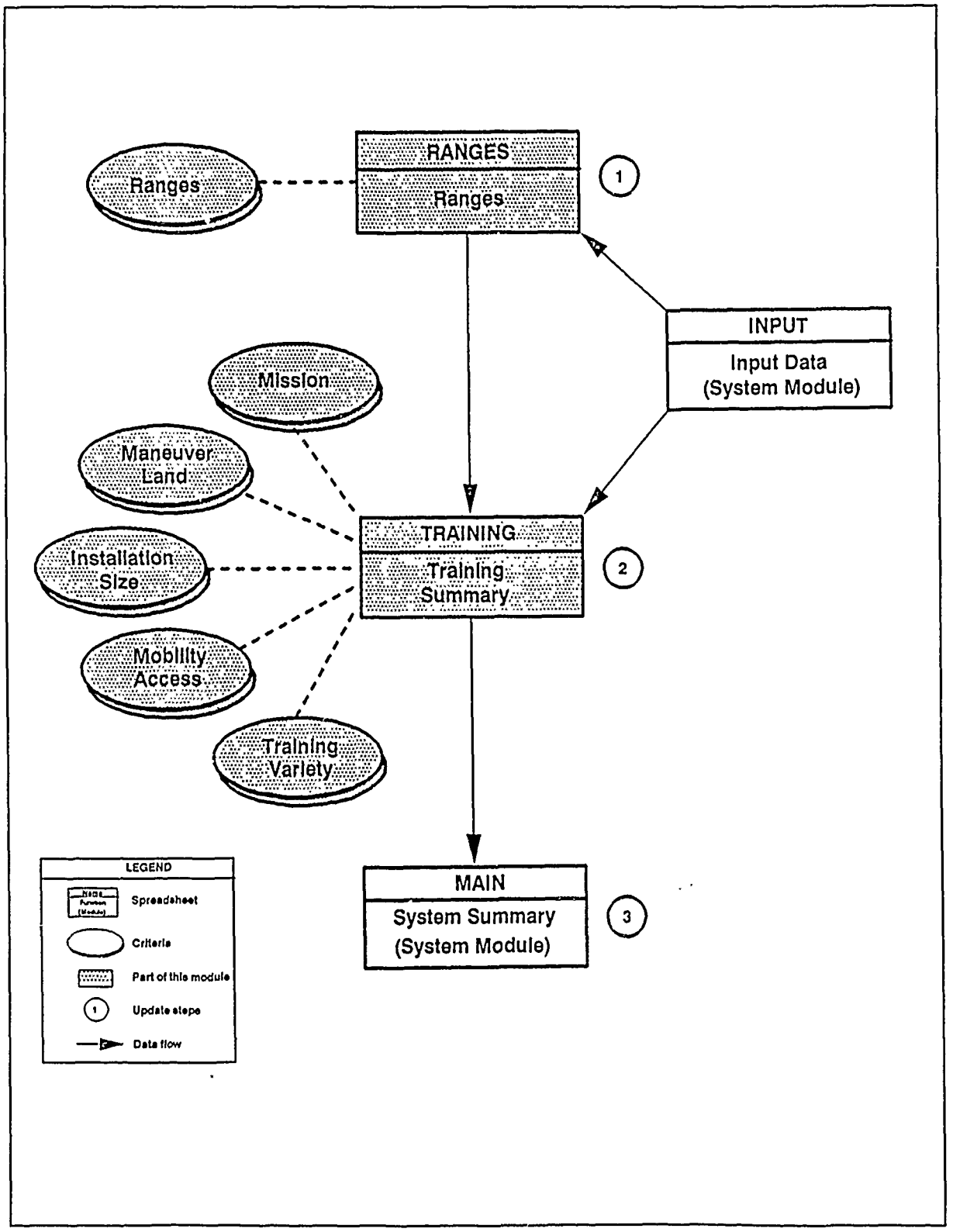

Figure 7. REVISED TRAINING MODULE STRUCTURE

and for all criteria. This results in two revised spreadsheets that are slightly smaller than the original spreadsheets. However, calculating more complex spreadsheets takes longer. The total update time for this module doubles to three minutes.[12]

d. **Base-case Revisions.** When stationing two or more units, the user must manually update the base case each time the user reaches a decision to station a new unit. The updating for a second unit is fairly simple for this module. The base case changes affect only the INPUT spreadsheet. For the installation which receives the first unit, the user revises military population, number of light and heavy brigades, and the use of ranges.

15. CHANGES TO CRITERIA. ESC changed the logic for three of the six criteria--mission, ranges, and mobility access. Because the training variety criterion is a function of installation specific aspects and does not relate to any combat arms unit characteristic, ESC made no changes to it. Two criteria, maneuver land and installation size, required only data changes described in paragraph 16.

a. **Mission Criterion.** For this criterion, ESC revised the mission compatibility sub-rating to consider battalion-size units. ESC assigned battalions a 10 if there was either no conflict or a conflict with a major school on the installation. The rating was a 9 for conflict with the National Training Center or equivalent. The rating remained a 1 because of electromagnetic transmissions at Fort Huachuca. **Figure 8** shows these new ratings compared to the previous ratings used for brigades and divisions.

MISSION CONFLICT	DIVISION	BRIGADE	BATTALION
None	10	10	10
Major School	4	8	10
National Training Center/ Joint Readiness Training Center	3	6	9
Electromagnetic Interference (only Ft. Huachuca)	1	1	1

Figure 8. MISSION COMPATIBILITY SUB-RATINGS

b. **Ranges Criterion.** For ranges, the original spreadsheet subtracted one point from the category rating for each brigade expected to use the ranges in that category. However, the spreadsheet fixed this subtraction for two specific brigade units (one point each) and two specific divisional units (three points each). This revision adds two tables. The first table lists the amount of points subtracted for each proposed unit (0.33 point subtracted for battalion-sized units). The second table lists the eight types of ranges a unit might need. **Figure 9** is an example of the latter table with sample data. Here, the user must mark which of the eight ranges each proposed unit requires.

[12] This time was measured on a Zenith 248 with 9 MHz clock.

PROPOSED UNIT	RANGE TYPE[1] CSW	AAW	ICS	IFW	ADA	AVN	MIC	ARM	Total Count[2]
Armored Division	1	1	1	1	1	1	1	1	8
Mech. Infantry Brigade	1	1	1	NA	NA	NA	1	1	5
Artillery Battalion	1	NA	NA	1	NA	NA	NA	NA	2
Combat Engineer Battalion	1	NA	1	NA	NA	NA	NA	NA	2

NOTE: Enter "1" for ranges required for each proposed unit.

[1] KEY:
CSW = Crew-served Weapons
AAW = Anti-armor Weapons
ICS = Infantry Collective Skills
IFW = Indirect Fire Weapons
ADA = Air Defense Artillery
AVN = Aviation
MIC = Mechanized Infantry/Cavalry
ARM = Armor

[2] Used in final calculations to determine average range rating.

Figure 9. RANGE USE TABLE WITH SAMPLE UNITS

c. **Mobility Access Criterion.** This final criterion also required a minor adjustment. Before, the TRAINING spreadsheet assigned fixed weights for the air and sea sub-criteria. In this revision, the user can select the weights for each specific combat arms unit. **Figure 10** is an example of the lookup table which stores the user selection for deployment weight mix.

16. CHANGES TO DATA. ESC made many data changes in the INPUT spreadsheet of the System Module which affect the criteria in the Training Module.

a. **Installation Data.** Since the 1988 DBSS, the Army reduced two active component, maneuver brigades from this study's base case. This reduction removes one heavy brigade from the 4th Infantry Division at Fort Carson and one light brigade from the 9th Infantry Division at Fort Lewis. These reductions affected two criteria:

(1) *Maneuver Land.* ESC revised the INPUT spreadsheet to list the correct number of light and heavy brigades per installation. This update calculated three to four battalions per brigade equivalent and rounded results to the nearest full brigade. The TRAINING spreadsheet extracts this data to calculate the required maneuver acreage as part of the maneuver land criterion.

(2) *Ranges.* ESC also revised the INPUT spreadsheet to list the base-case brigades using each of the eight ranges at each installation. In the 1988 *Division and Brigade Stationing Study*, ESC defined eight types of ranges, but only had data for six of them. For this effort, ESC added the missing initial ratings for air defense artillery and mechanized

	PROPOSED UNIT			
ACCESS	1	2	3	4
Air	0.25	0.25	0.25	0.25
Sea	0.75	0.75	0.75	0.75
TOTAL	1.00	1.00	1.00	1.00

Figure 10. EXAMPLE OF A DEPLOYMENT WEIGHT MIX WITH DEFAULT VALUES

infantry/cavalry range groups for most installations[13]. This addition also improved accuracy of the final rating, since ESC had originally entered zeros for unknown range ratings. ESC also added the use of individual/crew-served weapons ranges for all combat arms brigade equivalents. Finally, ESC revised ranges at several TRADOC installations based on student load. The RANGES spreadsheet extracts this data to calculate the rating of each range type at each installation. The RANGES spreadsheet adjusts the range ratings to arrive at the final values for the range criterion.

b. **Proposed Units Requirements.** In the INPUT spreadsheet, ESC updated the values for training acreage, ranges used, and population of the proposed units. These data affect the installation's ratings of four criteria--mission, maneuver land, installation size, and ranges. In the TRAINING spreadsheet, ESC changed one default user selection--the deployment weight mix for the mobility access criterion. Of course, the user may modify ESC's choice on this or any default.

17. SUMMARY OF THE TRAINING MODULE. The spreadsheets calculate brigade and division units using multiples of battalion maneuver data. This architecture allowed ESC to easily change spreadsheet logic to add battalion-size units to the module. In some cases, the switch from four specific generic units to any four combat arms units requires the user to research more unit data. However, the Training Module is now more flexible at the slight increase in update time.

[13] New data from *Division and Brigade Stationing System: Installation Data Book* (ESC, April 1988).

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IV. FACILITIES MODULE

18. **GENERAL.** A major cost associated with any large stationing action is the cost of facilities to house, train, and provide for the soldiers, their families, and the associated civilian workforce. Unlike the other two modules, the Facilities Module does not calculate individual criteria ratings. Instead, ESC computed the total estimated construction costs for all nine types of facilities needed by proposed units.[14] The module adjusts these estimates to account for regional differences and totals them. In this module, the highest ranking installation is the one with the lowest total estimated construction cost.

19. **CHANGES TO SPREADSHEET STRUCTURE.**

a. **Cosmetic Changes.** ESC did not alter the basic architecture of any of the ten facilities spreadsheets, which are shaded grey in **Figure 11.** ESC redesigned the menus for each spreadsheet and replaced references to the generic units with generalized or variable references. For example, most spreadsheets had several menus which referenced the light separate brigade. We replaced this specific name with a variable reference to the name for the first proposed unit, whatever it happened to be. ESC also streamlined macros to operate more efficiently and to inform the user of progress with messages.

b. **Significant Changes.** ESC reworked all the data entry menus throughout the Facilities Module so a menu reappears automatically when the user finishes. In response to the change in the housing criterion, ESC also changed the structure of the two housing spreadsheets. In the HOUSEBC spreadsheet, we inserted extra columns into an existing range. In the HOUSING spreadsheet, we created a new range to extract a subset of data from the INPUT spreadsheet. In both housing spreadsheets, ESC added a single user selection so the user could say which data to use. The next paragraph explains this more fully.

20. **CHANGES TO CRITERIA.** Of the nine facilities criteria, only housing changed substantially. The Division and Brigade Stationing System estimated the on-post housing construction cost based on data from several sources, including the 1980 U.S. Census. Since the sponsor had asked ESC to use their housing data, we added a user selection. The user can say whether the spreadsheet uses the complex method (census data) or the new *shortcut* method (OACE data). Depending upon the user's response, the spreadsheet transfers the designated data and inserts it into the appropriate steps of the calculation procedure. To accommodate this change, ESC altered two Facilities Module spreadsheets, HOUSEBC (base-case housing) and HOUSING (proposed unit housing).[15]

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[14] These estimated costs excluded the cost of construction necessary to correct any existing facility deficiency.

[15] This change indirectly affects some of the other facilities spreadsheets and the socioeconomic spreadsheet. The housing spreadsheets pass different data depending on the user's decision here.

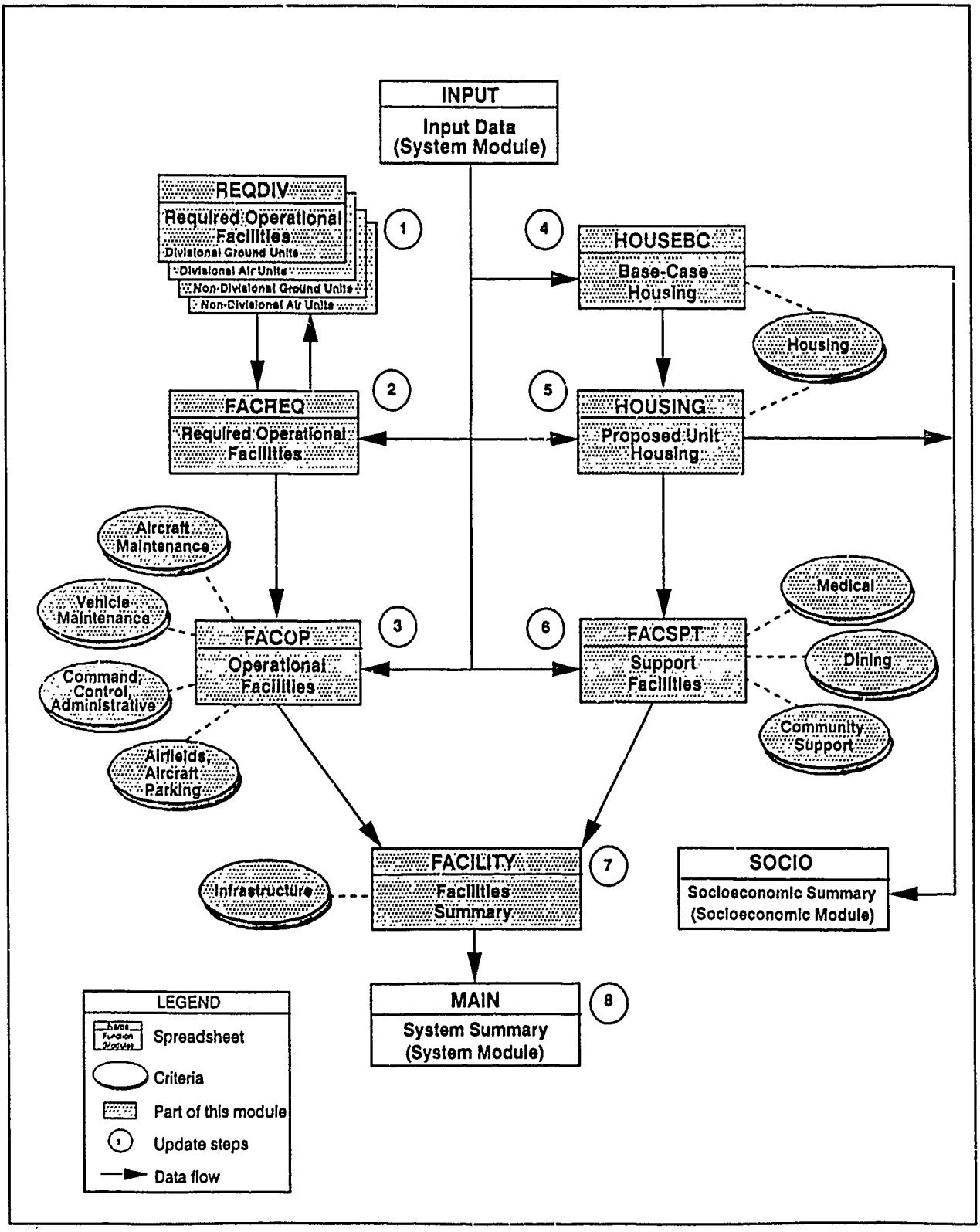

Figure 11. REVISED FACILITIES MODULE STRUCTURE

21. CHANGES TO DATA.

a. **Installation Data.**

(1) *Data Updates.* Using recent Integrated Facilities System (IFS) data, ESC updated the existing facilities data.[16] The OACE updated the programmed facilities from the Construction Appropriations Programming Control and Execution System (CAPCES) data base.[17] After checking the latest guidance, ESC adjusted some of the unit cost and regional cost factor data. ESC entered populations of officers, enlisted, students, and civilians for each installation. This data on the Table of Organization and Equipment (TOE), the Table of Distribution and Allowances (TDA), and tenant units were from the most recent *Army Stationing Installation Plan* (ASIP).[18] Using the ASIP, we updated the data on the base-case units at each installation in the facilities requirements (FACREQ) spreadsheet.

(2) *Change Source for Housing Data.* Since 1987, the Army installations have been collecting housing data with Segmented Housing Market Analyses (SHMA). When ESC was loading data into the Division and Brigade Stationing System in 1988, SHMA housing data was not available for enough installations. The OACE was recently able to get SHMA housing data for nearly all of the 28 installation complexes. From the *DD Form 1523, Projected Family Housing Requirements*, ESC extracted the effective requirement, the number of on-post units, and the number of off-post units.[19] From the *DD Form 1657, Determination of Unaccompanied Personnel Housing (UPH) Requirements*, ESC extracted the effective requirement, the number of on-post units, and the number of off-post units.[20]

(3) *User Selections.* ESC left at their default values those user selections which affected the base case.

b. **Proposed Unit Data.** For each proposed unit, ESC entered military population, the percent of civilian support workers and requirements for five facilities--aircraft maintenance, vehicle maintenance, command and control, administration, and aircraft parking. For the medical criterion, ESC entered the cost directly. These data affect the installation's ratings of all nine facilities criteria. ESC did not change any of the user selections which affect the proposed units.[21]

22. SUMMARY OF THE FACILITIES MODULE. In general, most changes are transparent to the user. ESC streamlined procedures and added messages. Of course, we updated data and added new data for the short method of calculating housing requirements. The two housing spreadsheets, HOUSING and HOUSEBC, each have an added question about whether the user wants to use the long or the short method.

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[16] Courtesy of the Engineering and Housing Support Center, U.S. Army Corps of Engineers, (Fall 1989).

[17] Courtesy of the Department of the Army, Assistant Chief of Engineers, Construction Programming Division, (October 1989).

[18] *Army Stationing Installation Plan* (U), computer generated report (Department of the Army, Assistant Chief of Engineers, Installation Planning Division, July 1989).

[19] Data are a mixture of 1987, 1988 and 1989 data.

[20] Ibid.

[21] These values are found in Annex D of *Division and Brigade Stationing System: An Overview*, (ESC, May 19[illegible]).

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V. SYSTEM MODULE

23. GENERAL. The System Module integrates the results of the three separate modules into a cohesive package. As diagrammed in **Figure 12**, the MAIN and INPUT spreadsheets form the System Module.

24. CHANGES TO SPREADSHEET STRUCTURE.

a. **Cosmetic Changes in Both Spreadsheets.** ESC redesigned the menus for both spreadsheets and replaced specific new unit references with generalized or variable references. ESC also renamed ranges which referred to specific new units. We rewrote the macros to operate more efficiently, and advise the user with messages.

b. **Significant Changes in MAIN Spreadsheet.** Although the structure of the MAIN spreadsheet did not change, ESC improved the sorting routine. We removed the step that temporarily stored the results for each proposed unit on the hard disk. In its place, ESC used a

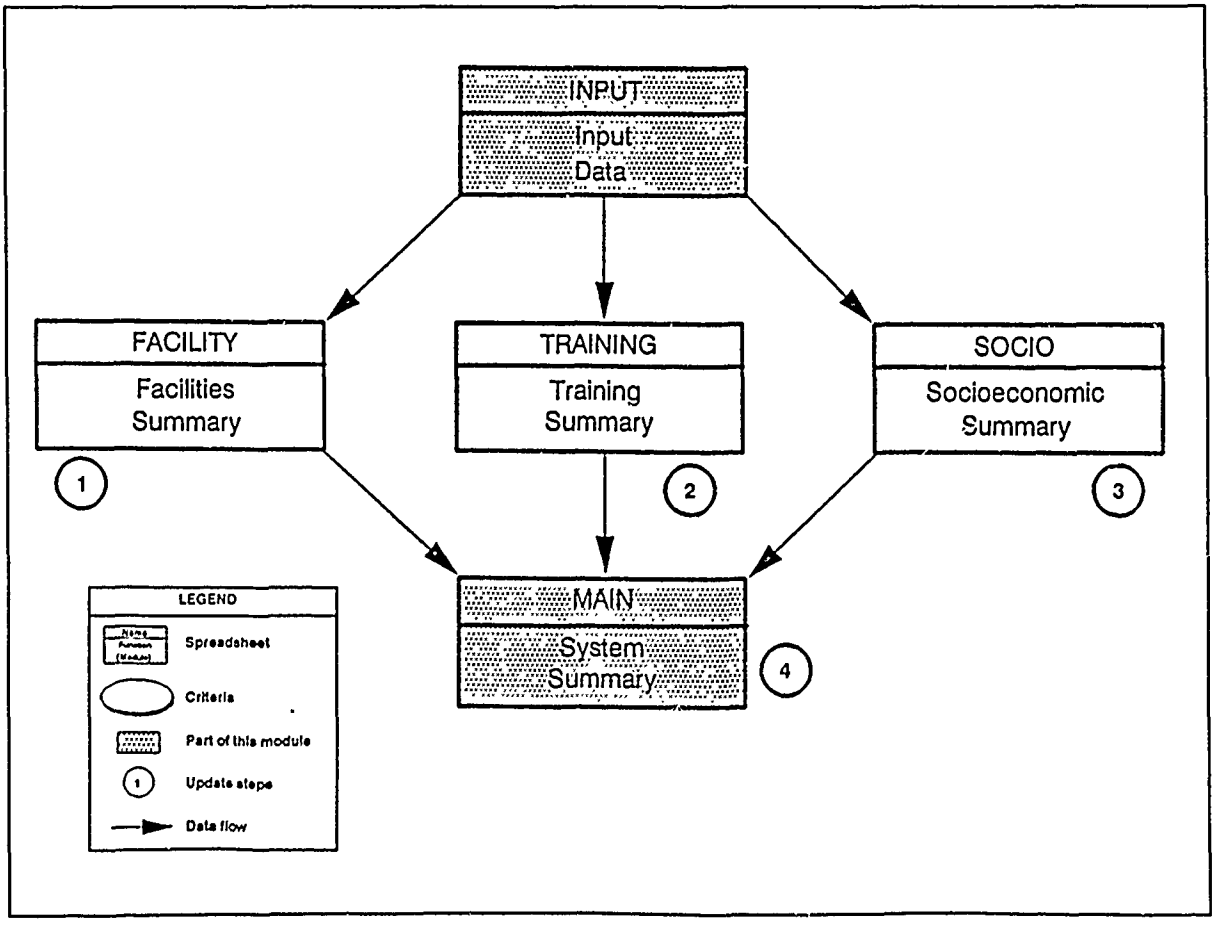

Figure 12. REVISED SYSTEM MODULE STRUCTURE

command which copies the results into the proper area without copying the associated formulas.[22] The MAIN spreadsheet then readily sorts these results by overall rating.

c. **Significant Changes in INPUT Spreadsheet.** In response to the change in the housing criterion described in paragraph 19, ESC added extra columns. We also enlarged an output range to allow the HOUSING and HOUSEBC spreadsheets to extract this data more easily. ESC altered menus so when the user finishes entering a set of data, the menu reappears automatically .

25. CHANGES TO DATA.

a. **Installation Data.**

(1) *Data Update.* As noted in previous sections, ESC and OACE updated most of the data in the INPUT spreadsheet. For each commute area, ESC updated total income, regional cost index, and the regional multiplier. For each local area, ESC updated population and surface area. For each installation, ESC updated populations, housing, existing facilities and programmed facilities. Based on the base-case units at each installation, ESC updated the use of ranges, maneuver areas, and the number and type of each unit. ESC also updated unit construction cost factors which apply to facilities at all installations.

(2) *Change Source for Housing Data.* As noted in paragraph 20, OACE provided housing data which ESC added to the INPUT spreadsheet.

b. **Proposed Unit Data.** For each proposed unit, ESC entered data on population, civilian support workers, land and air activity, training acreage, ranges used, and facilities requirements.

26. SUMMARY OF THE SYSTEM MODULE. Most of the changes are relatively transparent to the user. In both spreadsheets, ESC reworked macros and added messages to the user. In the INPUT spreadsheet, ESC updated data and added housing data from a different source.

[22] The /RangeValue command eliminated the need for the temporary spreadsheet, TRANSFX.WK1, which we deleted.

VI. SUMMARY AND RECOMMENDATIONS

27. ASAS--AN IMPROVED STATIONING SYSTEM. ESC's Army Stationing Alternatives System is a significant improvement over its predecessor, the DBSS. The new ASAS can support a decision to station any set of units composed of combat arms divisions, brigades, *and battalions.* The system is now more fully automated and user friendly. ESC updated the information about installations with the most recently available data. The ASAS was thoroughly tested and exercised with actual units currently located outside the US. For each of these proposed units, the system--

- Rated suitability of the installation's ranges and maneuver areas.
- Rated social and economic impacts on the civilian community.
- Estimated the cost of new facilities required.
- Ranked installations for their suitability to accept proposed units.

28. A ROLE IN A RAPIDLY CHANGING WORLD.

a. At least two major forces are driving the Army toward planning in which the ASAS could make a significant contribution. First, recent political upheavals in Europe have caused the US to reassess the threat there. Second, the defense budget will be increasingly austere over the next few years.

b. The ASAS can help the Army plan logical responses to these changes by--

- finding sites to station units returning from overseas.
- relocating units displaced from closed installations.
- identifying installations not suitable for combat arms units and therefore good candidates for closing.

29. OBTAINING THE ASAS. ESC designed the ASAS to operate on a microcomputer.[23] If an agency desires a working copy, please send your request to--

Commander/Director
U.S. Army Engineer Studies Center
ATTN: CEESC-MA (Mr. Brannon)
Casey Building 2594
Fort Belvoir, VA 22060-5583

[23] The user must have *Lotus 1-2-3* (version 2.0 or higher) and 640K of RAM.

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LAST PAGE OF MAIN PAPER

ANNEX A

ABBREVIATIONS AND ACRONYMS

LIST OF ABBREVIATIONS AND ACRONYMS

AAW	anti-armor weapons
ACE	Assistant Chief of Engineers
ADA	air defense artillery
AK	Alaska
AL	Alabama
AR	Arizona
ARM	armor
ASAS	Army Stationing Alternatives System
ASIP	Army Stationing and Installation Plan
AVN	aviation
CA	California
CAPCES	Construction Appropriations Programming Control and Execution System
CO	Colorado
CONUS	continental United States
CSW	crew-served weapons
DA	Department of the Army
DBSS	Division and Brigade Stationing System
ESC	Engineer Studies Center
FACREQ	facilities requirements
FY	fiscal year
GA	Georgia
HI	Hawaii
ICS	infantry collective skills
IFS	Integrated Facilities System
IFW	indirect fire weapons
KS	Kansas
KY	Kentucky
LA	Louisiana
LRSS	Long Range Stationing Study

MA	Massachusetts
MIC	mechanized infantry/cavalry
MHz	megahertz
MO	Missouri
NC	North Carolina
NJ	New Jersey
NM	New Mexico
NY	New York
OACE	Office of the Assistant Chief of Engineers
OCONUS	outside continental United States
OK	Oklahoma
PA	Pennsylvania
SC	South Carolina
SHMA	Segmented Housing Market Analysis
TDA	Table of Distribution and Allowances
TOE	Table of Organization and Equipment
TX	Texas
UPH	unaccompanied personnel housing
VA	Virginia
WA	Washington
WI	Wisconsin

LAST PAGE OF ANNEX A

	ARMY STATIONING ALTERNATIVES SYSTEM (ASAS)	STUDY GIST CEESC-R-90-10

THE PRINCIPAL FINDINGS:

(1) The Army's available automated data bases and systems are still not sufficiently developed to support a totally automated, stationing decision support system.

(2) For most proposed actual units, there are only a few installations which are highly rated for all three of the major groupings of criteria: environmental and socioeconomic, training and operations, and facilities.

THE MAIN ASSUMPTIONS:

(1) The training needs of base-case units (those already stationed) of battalion-size or larger can be adequately expressed by classifying these units as brigade equivalents of either light or heavy brigades.

(2) Base-case facilities requirements (needs) can be estimated by using only *active component* Army divisional units, non-divisional units of company-size or larger, and major TDA units.

THE PRINCIPAL LIMITATIONS:

(1) Since the Army's available automated systems could not support a totally automated system, the ASAS uses automated, automation-assisted, and manual data collection and manipulation techniques.

(2) OCONUS installations were not examined.

(3) Reserve component units are not considered to be part of the base-case force, i.e., reserve units do not use facilities that are not specifically set-aside for their use.

THE SCOPE OF THE STUDY:

(1) Revise the methodology which formerly rated the ability of installations to accept four specific maneuver brigades and divisions. This revision adds the ability to station active component, battalion-sized units. The revised model rates installations for any four combat arms battalions, brigades or divisions.

(2) Update data for Fiscal Year 1992 (FY92) which had changed between 1988 and 1990.

(3) Apply this methodology to screen 28 Army installations in CONUS, Alaska, and Hawaii to determine the most likely candidates for the stationing of selected units. Rather than publish the classified results, ESC gave them directly to the sponsor.

THE STUDY OBJECTIVE: To revise an existing, automated, decision support system so that the new system:

(1) Screens installations to identify the most suitable candidates for the peacetime stationing of additional combat arms divisions, brigades, and battalions.

(2) Could be used routinely by DA and MACOM stationing planners.

(3) Could be easily updated by informed users in response to changes in force structure, installation stationing, or weapons systems.

THE BASIC APPROACH: The study was organized into three phases:

(1) The study team examined the existing Division and Brigade Stationing System (DBSS) to determine what data they would update and requested the data.

(2) ESC revised the existing DBSS spreadsheets to accommodate new combat arms battalions. The twenty criteria remain unchanged from the original Division and Brigade Stationing System. For all criteria, the higher an installation's rating, the more capable it is of accepting a new unit.

(3) ESC exercised the model by stationing battalions, brigades, and divisions. The System Module multiplies the criteria ratings from the other three modules by user weights and sums them into an overall score. The System Module uses this score to rank each installation on its ability to accept an additional unit. After locating the first unit at the most suitable installation, ESC updated the data and exercised the model again for a second unit. In this stepwise fashion, ESC created a stationing scheme for all the new units.

THE REASONS FOR PERFORMING THE STUDY:

(1) The Assistant Chief of Engineers (ACE) asked ESC to analyze the facilities implications of re-stationing actions which might result from political decisions to reduce troop strengths OCONUS.

(2) The study organization had previously performed quality stationing analyses of similar scope for the same sponsor.

THE STUDY SPONSOR: The sponsor of the study was the Assistant Chief of Engineers, Installation Planning Division.

THE PERFORMING ORGANIZATION AND PRINCIPAL AUTHORS: The US Army Engineer Studies Center performed this study. The authors were Mr. Joseph D. Brannon and Mr. Douglas K. Lehmann.

THE DTIC ACCESSION NUMBER OF FINAL REPORT: None

THE COMMENTS AND QUESTIONS MAY BE SENT TO: Cdr/Dir, US Army Engineer Studies Center, Casey Building #2594, Fort Belvoir VA 22060-5583.

THE START AND COMPLETION DATES OF THE STUDY: Starting Date: September 1989.
Completion Date: May 1990.